

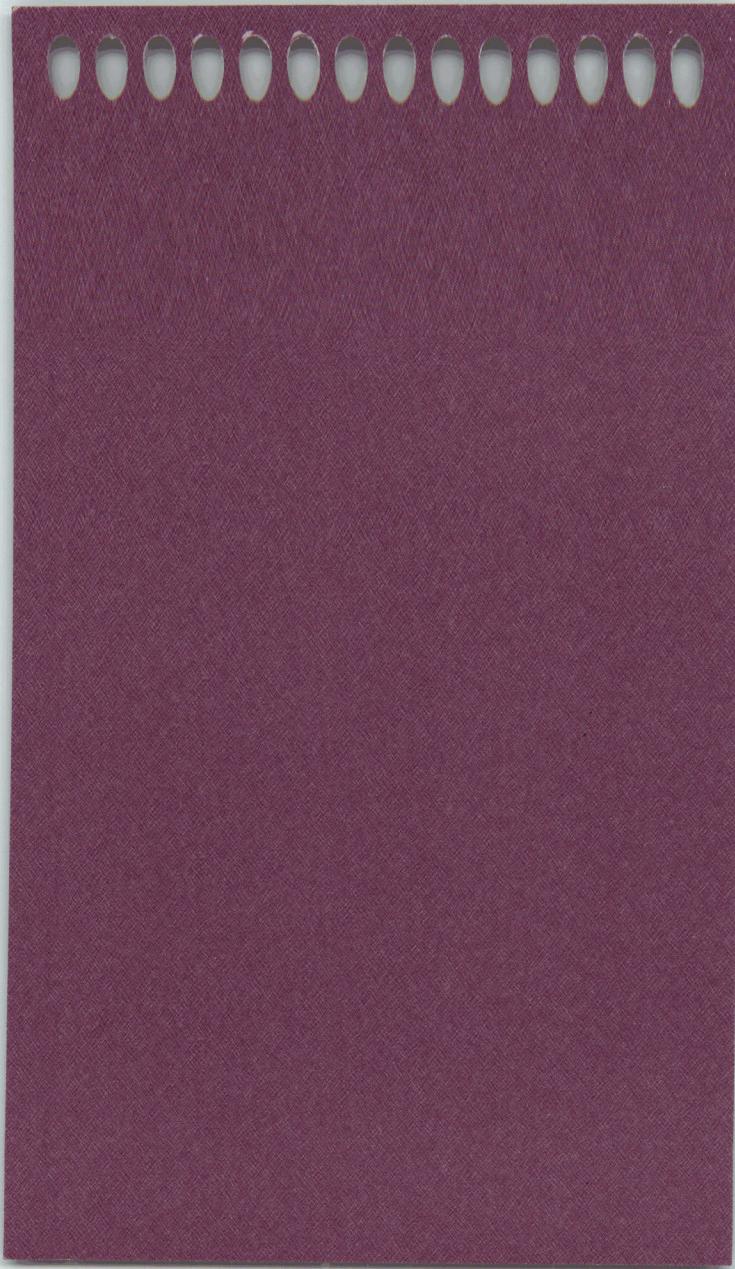
**P O R T A B L E
C H A N G E A B L E
M E S S A G E S I G N**

H A N D B O O K

PCMS



U.S. Department
of Transportation
Federal Highway
Administration



Introduction .....	.1
What is a PCMS? .....	.2
When Should a PCMS be Used? .....	.3
PCMS Screen Characteristics .....	.5
Matrix Types .....	.5
PCMS Message Design Process .....	.7
Message Selection .....	.7
Message Display .....	.7
Default Message .....	.8
Changing a PCMS Message .....	.9
Standard Abbreviations .....	.9
Display Time .....	.14
Maximum Number of Phases .....	.14
Placement of a PCMS .....	.16
Laterally .....	.16
Longitudinally .....	.17
PCMS Height .....	.18
Sight Distance .....	.19
When to Discontinue PCMS or Alter Message .....	.20
Other Operational Issues .....	.21
Brightness .....	.21
Maintenance .....	.22
Appendices .....	.23
Setup Checklist .....	.23
Definitions .....	.24
Metric Conversions .....	.25

TABLE OF CONTENTS

EMERGENCY TELEPHONE NUMBERS

Other _____

Medical _____

Fire _____

Police _____

Shop _____

Office _____

Supervisor _____

District Traffic Unit _____

County Office _____

The purpose of this handbook is to present basic guidelines for the use of portable changeable message signs (PCMS). This handbook presents information on the PCMS and is intended to illustrate the principles of proper PCMS use.

This handbook is not intended to be a standard.

Standards that apply to the PCMS are found in the *Manual on Uniform Traffic Control Devices* (MUTCD) at <http://mutcd.fhwa.dot.gov/>.

1

INTRODUCTION

A PCMS:

- ◀ Captures motorists' attention.
 - ◀ Relays information that is difficult to accomplish with static signing.
 - ◀ Is used to supplement other required signing.
- A PCMS is a traffic control device that is capable of displaying a variety of messages to inform motorists of unusual driving conditions. This capability is achieved through elements on the face of the sign that can be activated to form letters or symbols. The message is limited by the size of the sign (usually three lines with eight characters per line). A PCMS is housed on a trailer or on a truck bed and can be deployed quickly for meeting the temporary requirements frequently found in work zones or accident areas.

A PCMS can be used to alert and inform motorists during one of the following scenarios:

- ▶ Construction or maintenance (e.g., work zone).
- ▶ Incident management.
- ▶ Special event.
- ▶ Notification of future construction or event.

A PCMS can provide a unique message that alerts the motorist and supports standard signing for:

- ▶ Speed reduction.
- ▶ Advance notice of lane closures and shifts.
- ▶ Diversion to a different route.
- ▶ Advance notice of ramp closures.

A PCMS also can provide informational messages, such as:

- ▶ Expected reopening of existing closed lane.
- ▶ Roadway status for special events.
- ▶ Crash or other incidents.
- ▶ Changes in alignment or surface conditions.

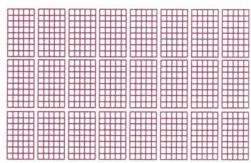
3

WHEN SHOULD A PCMS BE USED?

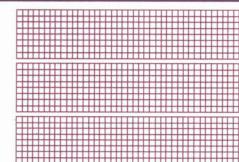
A PCMS can be an effective temporary traffic control device when used appropriately. By its very nature, it draws the attention of the motorist; however, this effect can be diminished if this device is overused. The PCMS should not replace any of the signing detailed in the MUTCD and should not be used if standard traffic control devices adequately provide the information the motorist needs to travel safely.

Matrix Types

The type of message screen can affect the message that is chosen and the distance at which it can be read. Three screen types (or matrix types) are described below:



Modular—The simplest matrix-type signs are those that are comprised of character blocks. A sign would have, for example, three lines with eight character blocks per line.



Continuous Line Matrix—A somewhat more flexible type of PCMS uses a continuous matrix for each line of text. These signs offer the ability to use proportionally spaced fonts, as opposed to the monospaced text displayed by discrete character blocks. The benefits include a more natural-looking sign and, therefore, an easier-to-read message.

Character Height, inches	Legibility distance, feet
54	2160
24	960
18	720
The legibility distance of the character depends on its height.	The legibility distances to the left are based on the standard character height 25.4 mm (1 inch).

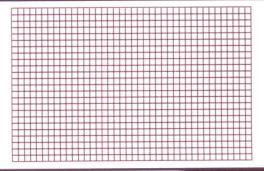
1 ft = .306 m
1 inch = 25.39 mm

Dependning on the matrix type, the height of a character can vary from 457 to 1372 millimeters (mm) (18 to 54 inches). Most PCMS units allow only eight characters on a line, no matter what the character height. Each character shall, as a minimum, be five pixels wide by seven pixels high.

Depending on the matrix type, the height of a character can vary from 457 to 1372 millimeters (mm) (18 to 54 inches). Most PCMS units allow only eight characters on a line, no matter what the character height. Each character shall, as a minimum, be five pixels wide by seven pixels high.

PCMS is the most flexible type. The entire sign face is comprised of elements or pixels that can be activated to display a message. These signs offer the ability to vary the height of characters, display simple graphics, and use proportionally spaced fonts.

Full Matrix—The full-matrix



Message Selection

PCMS use on construction and maintenance projects should be treated as an integral part of the traffic control plan (TCP). Desired messages, locations, and general time periods of display should be listed for all known or anticipated PCMS use during the project. Of course, additional opportunities to use the PCMS may come up during the life of the project, and the TCP should allow for these unanticipated messages. However, the governing agency should retain control over selection and display of the unanticipated messages.

Message Display

A PCMS message can use one, two, or, when absolutely necessary, three phases in which to relay its message. Below are message guidelines for the number of phases required to convey the message.

One-Phase PCMS:

- Line 1—Describe problem.
- Line 2—Identify location or distance ahead.
- Line 3—Provide motorist instruction.

7

PCMS MESSAGE DESIGN PROCESS

Default Message

A default message should be programmed into the PCMS in case the unit becomes disabled. Since the default message will act as a warning to field personnel that the PCMS has malfunctioned, a message should be chosen that will not alarm motorists and will not be used for any other purpose. Alternatively, to indicate that the PCMS is malfunctioning, a pattern such as solid bars may be used.

Care must be given to ensure a short message length and to avoid repeating messages covered by static signaling.

Three-Phase PCMS:
Phase 1—Describe problem.
Phase 2—Identify location or distance ahead.
Phase 3—Provide motorist instruction.

Two-Phase PCMS:
Phase 1—Describe problem.
Phase 2—Provide motorist instruction.



Changing a PCMS Message

It is desirable to have the PCMS display the most correct and appropriate information to the motorist as possible. However, there are times when the PCMS will not have the desired message as one of the standard messages in the database. In this case, the required message must be added to the database.

The control system needs to include a display screen upon which messages can be reviewed before being displayed on the PCMS.

It is recommended that an instruction manual be stored with the PCMS for in-field programming of the message.

Standard Abbreviations

Abbreviations may be used when creating or editing PCMS messages. **Do not make up abbreviations;** use the following list of standard abbreviations to ensure that the motorist does not misinterpret the message.

9

PCMS MESSAGE DESIGN PROCESS

(continued)

Word	Abbrev.	Word	Abbrev.	Word	Abbrev.	Word	Abbrev.	Word	Abbrev.
Alliterate	ALT	Highway	Hwy	Avenue	AVE, AV	Hour(s)	HR	Boulevard	BLVD
Alternate	ALT	Highway	Hwy	Hour(s)	HR	Information	INFO	Cantat	CANT
Cannot	CANT	It is	ITS	Junction	CNTJ	Do Not	DONT	Lane	LNE
Center	CNTJ	If Is	ITS	junction	CNTJ	Do Not	DONT	Left	LFT
Emergency	E-BND	Maintainance	MINT	ENTer	ENT	Normal	NORM	Expressway	EXPWY
Extrance	E-BND	Maintenace	MINT	ENTer	ENT	North	N	Freeway	FRWY,
Extrance	E-BND	Maintenace	MINT	ENTer	ENT	Normal	NORM	Expressway	EXPWY
Extrance	E-BND	Maintenace	MINT	ENTer	ENT	Northbound	N-BND	Expressway	EXPWY
Extrance	E-BND	Maintenace	MINT	ENTer	ENT	Parking	PKNG	Freeway	FRWY,
Extrance	E-BND	Maintenace	MINT	ENTer	ENT	Road	RD	RHT	RHT
Extrance	E-BND	Maintenace	MINT	ENTer	ENT	Service	SERV	SHLDR	SHLDR
Extrance	E-BND	Maintenace	MINT	ENTer	ENT	Shoulder	SHLDR	SLIP	SLIP
Extrance	E-BND	Maintenace	MINT	ENTer	ENT	Slipperry	SLIP	Vehicel	Vehicel
Extrance	E-BND	Maintenace	MINT	ENTer	ENT	HOV	HOV	Occupancy	Occupancy

Abbreviations Accepted

Word	Abbr.	Word	Abbr.
South	S	Travelers	TRVLRS
Southbound	S-BND	Vehicle	VEH
Speed	SPD	Warning	WARN
Street	ST	West	W
Temporary	TEMP	Westbound	W-BND
Traffic	TRAF	Will Not	WONT

**Acceptable
Abbreviations
with Prompt
Word**

Word	Abbr.	Prompt
Access	ACCS	Road
Ahead	AHD	Fog*
Blocked	BLKD	Lane*
Bridge	BRDG	(name)*
Condition	COND	Traffic*
Congestion	CONG	Traffic*
Construction	CONST	Ahead
Downtown	DWNTN	Traffic*
Exit	EX, EXT	Next*
Express	EXP	Lane
Hazardous	HAZ	Driving
Interstate	I	(followed by route number)

*Prompt word goes before abbreviation.

(continued)

(continued)

Acceptable Abbreviations with Prompt Word

Word	Abbr.	Prompt
Local	LOC	Traffic
Lower	LWR	Level
Major	MAJ	Accident
Minor	MNR	Accident
Oversized	OVSZ	Load
Prepare	PREP	To Stop
Pavement	PVMT	Wet*
Roadwork	RDWK	Ahead
Route	RT, RTE	Best*
Trumpike	TRNPK	Route
Townsship	TWNSP	Trumpike
Upper	UPR	Townsship
Level	LEV	Upper
Limits	LIM	Level
(name)*	(NAME)*	Limits

*Prompt word goes before abbreviation.

**Abbreviations
That Are Not
Acceptable**

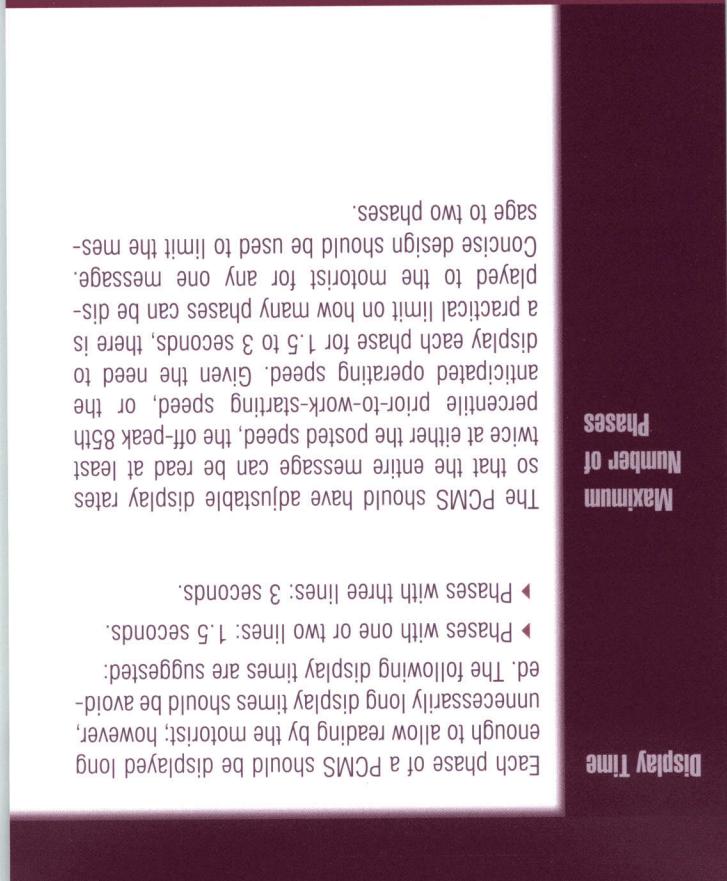
Abbr.	Intended Word	Common Misinterpretation
ACC	Accident	Access (Road)
B4	Before	None
CLRS	Clears	Colors
DLY	Delay	Daily
FDR	Feeder	Federal
L	Left	Lane (Merge)
LT	Light (Traffic)	Left
PARK	Parking	Park
POLL	Pollution (Index)	Poll
RED	Reduce	Red
STAD	Stadium	Standard
WRNG	Warning	Wrong

REMEMBER:

- ▶ Signs are the primary channel of communication to the motorist.
- ▶ PCMS credibility is crucial.
- ▶ The PCMS should communicate what action motorists need to take and when this action should occur.
- ▶ Unnecessary information should be avoided.
- ▶ PCMS should be left blank if there is nothing to report and moved if no longer needed.

13

PCMS MESSAGE DESIGN PROCESS



The conditions in the following table could allow motorists sufficient distance and time to read three phases twice.

Character Height, inches	Speed, mph
18	40
24	50
54	Any

1 inch = 25.39 mm
1 mile (mi) =
1.61 kilometers (km)

These conditions are based on a presumed PCMS minimum character legibility of 40-to-1 of character height. It should be noted that different technologies will affect the character legibility.

REMEMBER:

- ▶ One-phase messages are ideal.
- ▶ Two-phase messages are acceptable if necessary.
- ▶ Three phases should be used only when necessary and should contain a simple message.
- ▶ The message can be split into two PCMS units if desired.
- ▶ Do not flash a message to attract the motorist's attention. This practice has been found to be a distraction to motorists, especially at night.
- ▶ Do not allow the message to scroll or travel horizontally or vertically across the face of the sign.

In addition, the PCMS should be placed on level ground and turned 3 degrees toward the roadside.

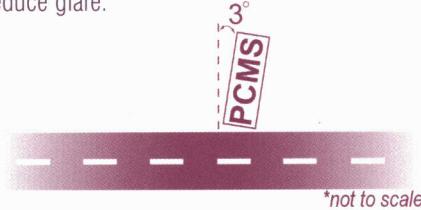
- Roadway curvature.
- Number of lanes.
- Distance the PCMS is placed from the side of the road.

Care should be taken not to place the PCMS so far off the roadway that the PCMS is not in the motorist's cone of vision long enough to read the message. Factors that change the motorist's cone of vision are:

If possible, the PCMS should be placed closest to the lane for which the message applies. The PCMS normally is placed on or just outside the shoulder. A PCMS can become a roadside hazard if it is not protected from an errant vehicle. If it cannot be protected by a guardrail or barrier, then it is recommended that orange cones or drums be used to increase the likelihood that motorists will notice the PCMS.

Laterally

from the perpendicular edge of the roadway to reduce glare.



*not to scale

Longitudinally

The placement of a PCMS depends on how far upstream it needs to be placed and whether the upstream location has a sufficient sight distance for the PCMS to be viewed before motorist action is required.

The upstream location from the decision point depends on what type of action is required of the motorist. An example of a minor action is a lane change by the motorist. A major action would be the motorist having to make a detour from the current road.

For a minor action, the PCMS should be placed from 152.5 m to 305 m (500 ft to 1,000 ft)

PCMS Height**Longitude**
(continued)

When in operating mode, the bottom of the PCMS message panel shall be at least 2 m (7 ft) above the roadway.

There should be a minimum spacing of at least 305 m (1,000 ft) between PCMS units or a PCMS and an arrow panel. Multiple PCMS units should be placed on the same side of the road-way.

For a major action, if the speed is less than or equal to 64 kilometres per hour (kph) (40 miles per hour (mph)), the PCMS should be placed at least 305 m (1,000 ft) upstream of the decision point. If the speed is greater than or equal to 72 kph (45 mph), then the PCMS should be placed at least 1.61 km (1 mi) upstream of the decision point. If the speed is greater than or equal to 72 kph (45 mph), the PCMS should be placed at least 1.61 km (1 mi) upstream of the decision point.

Upstream of the decision point, regardless of speed.

Sight Distance

For highway travel, it is desirable to have a visibility distance of 0.8 km (0.5 mi) for a PCMS, while for slower travel, shorter distances are acceptable. Keep in mind that because curves or hills may hide a PCMS, the PCMS may have to be located farther away from the decision point so that there will be enough time for the motorist to read the message.

In placing a PCMS, it is important to keep in mind that:

- ▶ The PCMS should be visible from 0.8 km (0.5 mi).
- ▶ Curves or hills may require an increase in spacing.

After the PCMS has been located in the field, verify that the sight distance is greater than the required visibility and legibility distances.

Finally, because local motorists become familiar with the new conditions so quickly, the PCMS should be moved periodically (e.g., every few weeks) so that it continues to command the attention of motorists.

19

PLACEMENT OF A PCMS

- Update PCMS information when possible.
- When not in use, the PCMS should be turned perpendicular to the flow of traffic so that motorists do not see its screen (if possible).

One of the most significant problems perceived with a PCMS is credibility. A failure to display the correct information on a PCMS creates a negative image in motorists' minds.

REMEMBER:

Brightness

Current PCMS boards operate by means of one of two technologies (neither of which allow for an adjustment of field brightness):

- ▶ Light-emitting diode (LED) boards are internally set at the factory to monitor ambient light levels and automatically adjust the brightness of the PCMS. These boards do not allow manual overriding of light intensity.
If an LED board is too dim under sunny conditions, or is excessively bright at night, that board should be replaced or it should be adjusted by the manufacturer.
- ▶ Flip-disk boards have no light source to be adjusted, as these are usually reflective disks.

Maintenance

- As with all mechanical equipment, routine maintenance is recommended to preserve the life of the CMS and to ensure that it is running safely and properly.
- ◀ Have an extra battery available (if the CMS is battery-powered).
 - ◀ Clean and inspect the following components:
 - Batteries (three or four times per year).
 - Solar panel(s) (monthly).
 - Sign door panel(s) (monthly).
 - Screen (monthly).
 - ◀ Verify that an extra set of programming instructions are stored in the PCMs for emergency use or for "in-the-field" programming.

Suggested maintenance steps include:

**Setup
Checklist**

- ✓ Does the PCMS tell the motorist to do something?
- ✓ Are static signs not readily available?
- ✓ Does the PCMS tell drivers something new?
- ✓ Has approximately 1.5 to 3.0 seconds of cycle time been provided for each phase of the PCMS so that each phase can be read twice?
- ✓ Have standard abbreviations been used?
- ✓ Can the PCMS be seen from the recommended visibility and legibility distances?
- ✓ Is the PCMS safely placed on or just off the shoulder?

REMEMBER:

- ▶ Move the PCMS periodically so that it continues to command the attention of the motorists.
- ▶ Black out or edit the PCMS message when it no longer applies.
- ▶ Ensure that the brightness of the PCMS changes automatically as required by lighting conditions.
- ▶ Maintain and clean the PCMS on a regular basis.

23

APPENDICES

Phase—Letters, words, and/or symbols displayed at one time.

Message—Group of characters, numerals, and symbols or a graphic image used to convey a warning or instruction. A message may be presented to the mototrist during one, two, or three phases.

Legibility Distance—Distance at which a motorist with normal vision can read a message.

Graphic—Array or configuration of pixels that forms an image or symbol for the purpose of conveying information.

Cycle Time—Time that the entire message is displayed.

Character—letter, numeral, or symbol formed by a group of pixels, usually an array of five-wide by seven-high pixels.

Definitions

**Metric
Conversions**

From English	Multiply By	To Metric
inch	25.4	millimeters (mm)
foot	0.30	meters (m)
yard	0.91	meters (m)
mile	1.61	kilometers (km)
mph	1.61	kilometers per hr (kph)

25

APPENDICES

Visit us on the Web at
www.tfhrc.gov

Turner-Fairbank Highway
Research Center
6300 Georgetown Pike
McLean, VA 22101

FHWA-RD-03-066
HRDS-05/01-04(6M.500)E